AD-A266 381

NTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	1 Dec. 19, 1991	Annual 1991

3

4. TITLE AND SUBTITLE
Polar Mesospheric Cloud Experiment

5. FUNDING NUMBERS
N00014-90-J-1277

6. AUTHOR(S)
Gary E. Thomas

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Laboratory for Atmospheric and Space Physics
University of Colorado
Campus Box 392
Boulder, CO 80309-0392

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Office of Naval Research
Natural Environment Program
Innovative Science and Technology Office
SDIO
4555 Overlook Avenue, SW, Washington, DC 20375-5000

10. SPONSORING MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION AVAILABILITY STATEMENT

This document has been approved for public release and sale; its distribution is unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

An ultraviolet two-channel imaging polarimeter (UVIP) has been constructed whose purpose is to make rocket-borne measurements of the optical properties of Polar Mesospheric Clouds (PMC). Launch into an PMC is scheduled for summer, 1992 from Poker Flat Range, Alaska. PMC have special relevance to midcourse systems because of the stressing backgrounds they produce in the principal threat corridors at high latitudes. In addition, we are carrying out numerical simulation of PMC structure using a multi-dimensional model.

14. SUBJECT TERMS	15. NUMBER OF PAGES
Polar Mesospheric Clouds, Optical Detection, Remote Sensing	4
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	

ANNUAL REPORT FOR FY 91

1) Contract Title: Polar Mesospheric Cloud Rocket Experiment

Number: N0001490J1277

Principal Investigator: G.E. Thomas
Laboratory for Atmospheric and Space Physics
University of Colorado
Campus Box 392, Boulder, CO 80309-0392
Tel: (303) 492-7022

Program Manager: Dr. William Hoppel

2) Technical Objectives

Design, build and launch on board a sounding rocket a photopolarimeter experiment which will determine information concerning the sizes and concentration of polar mesospheric ice particles. In addition, conduct theoretical studies on the two-dimensional aspects of polar mesospheric cloud structure.

3) Approach

From experience gained by analysis of data from the SME spacecraft, and from modelling the appearance of clouds as seen at the limb (at 85 km tangent height), we have formulated an experiment design to observe polar mesospheric clouds at the limb at two ultraviolet wavelengths and in two directions of linear polarization. This experiment was flown on a NASA Black Brant sounding rocket from a mid-latitude site (White Sands Missile Range). The purpose of this flight was to test the instrument performance in a non-PMC environment. The launch into a PMC from a high-latitude site (Poker Flat, AL) will take place in July-August, 1992.

4) Accomplishments During FY 90-91

We completed the construction of the instrument, and performed laboratory calibrations with regard to sensitivity, flat-field, and polarization response on a pixel-to-pixel basis. The instrument was integrated into the payload of the University of Michigan NASA experiment, and with the rocket sub-systems at Wallops Island. Launch occurred on September 6, 1991 at 1440 MST from the WSMR (32°N latitude). Preliminary analysis of the data indicates that the instrument performed nominally, with good quality data in all channels. A presentation of these results was given at the Fall meeting of the American Geophysical Union, San Francisco, CA on December 12, 1991.

5) Significance

The PMC experiment concept represents a significant enhancement in our abilities to study the atmospheric radiance environment in the crucial region 70-100 km. It is in this region where missiles will first be detected by space-based reconnaissance systems. Such systems will be hopelessly confused when attempting to separate out a moving target from the highly-structured clouds that are ubiquitous during the summer

months at high latitudes. Very little information is available on the basic physics of the clouds, why they form and dissipate in their observed wave patterns, and how various optical systems (UV, visible, and infrared) will respond to their presence. The PMC concept is designed to specifically answer the question of ice particle sizes and concentrations by using a seldom used tool for upper atmospheric probing, namely the polarization state of the scattered light.

6) Planned Effort for Remainder of Contract

We plan to refurbish the Ultraviolet Polarimeter, which was retrieved with very little damage from the White Sands launch. We will replace any broken components, and concentrate on reducing the read-out noise of the instrument. We will integrate the instrument at University of Michigan in the spring of 1992, and launch into a PMC from the Poker Flat, AL range in late July - early August, 1992. We also plan to perform a laboratory test of the measurement concept. This will be achieved by illuminating a laboratory sample of aerosols of known size, and measuring the scattered light at as many angles as practical. The laboratory test will take place at the Naval Research Laboratory, in collaboration with Dr. W. Hoppel.

We are completing the modeling effort to simulate the visual appearance of noctilucent clouds. This work (in collaboration with E. Jensen of NASA Ames and D. Fritts of the University of Colorado) is being written up for publication.

7) Presentations/Publications in FY 90-91

1. Thomas, G.E., Polar mesospheric clouds: UV observations (invited review paper), in *Proceedings of the Conference on Short Wavelength Phenomenology and* Applications, Applied Physics Laboratory, Johns Hopkins University, pp. 275-297, June 26-28, 1990.

2. Thomas, G.E., R.D. McPeters, and E.J. Jensen, Satellite observations of polar mesospheric clouds by the SBUV Radiometer: Evidence of a solar-cycle dependence, J. Geophys. Res., 96, 927-939, 1991.

3. Thomas, G.E., Mesospheric Clouds and the Physics of the Mesopause Region (invited review paper). Rev. Geophysics, 29, 553-575, 1991.

4. Rusch, D.W., E.J. Jensen, and G.E. Thomas, Particle size distribution in polar mesospheric clouds derived from SME measurements, J. Geophys. Res., 96, 12,933-12,939, 1991.

5. Jensen, E.J. and G.E. Thomas, Charging of mesospheric particles: Implications for electron density and particle coagulation, J. Geophys. Res., 96, 18,603-18,616, 1991.

6. Thomas, G.E. R. Kohnert, G.M. Lawrence, S.A. Stern, and J. Westfall, An ultraviolet imaging polarimeter experiment: Rayleigh scattering in the mesosphere, paper given at the Fall Meeting of the American Geophysical Union, S.F, CA, Dec. 1991.

8. Listing of principal participants at LASP:
   Gary E. Thomas (PI)
   G.M. Lawrence (Co-I)
   David C. Fritts (collaborator)
   A.J. Stern (collaborator)
   R. Kohnert (Engineer)
   J. Westfall (Engineer)

Collaborators at other institutions:
   William Sharp, University of Michigan
   Eric Jensen, NASA Ames Research Center
   John J. Olivero, Pennsylvania State University